PATENT SPECIFICATION

627,719

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PROVISIONAL SPECIFICATION

Improvements in and relating to Photographs and to Sensitive Photographic Materials

We, KODAK LIMITED, a Company registered under the Laws of Great Britain, of Kodak House, Kingsway, London, W.C.2, do hereby declare the nature of this invention (which has been communicated to us by EASTMAN KODAK COMPANY, a Company organised under the Laws of the State of New Jersey, United States of America, of 343, State Street, Rochester, New York, United States of America, and GALE FRANCIS NADEAU and EDWIN ERNEST JELLEY, both Citizens of the United States of America, both of Kodak Park, Rochester, New York, United States of America) to be as follows:—

This invention relates to improvements in photographs and in sensitive photographic materials.

In particular the invention relates to photographs and sensitive photographic materials wherein a light-diffusing layer is adjacent to one face of a transparent layer whose other face is in contact with a medium of lower refractive index such as air. It is known that such photographs and sensitive materials suffer from certain disadvantages. One example is a colour photograph having a multi-coloured transparent layer mounted for viewing on a light diffusing support. In such a case there is an appearance of high-light stain not noticeable in the transparency itself and an apparent reduction in colour saturation. Another example is a sensitive emulsion, which consists of a translucent but light-diffusing layer, mounted on a transparent support.

In application No. 7756/44 we have shown that these disadvantages can be eliminated or largely reduced by arranging between the light-diffusing layer and the transparent layer an intermediate layer of refractive index less than that of the transparent layer, e.g. a thin layer of air. It is best for the intermediate layer to be continuous but when this is air constructional difficulties may be encountered. It has now been found that it is possible to use for such intermediate layer a solid layer having dispersed therein finely divided particles, for instance a resinous layer containing a substantial proportion of a fluorine compound. The fluorine compound may be in solution. It has been further discovered, however, that the index of refraction of a layer is actually affected by materials dispersed therein provided the particles are less than .2 microns in diameter. Particles about .1 micron are of course far above molecular dimensions and yet they do contribute to the refractive index of the medium in which they are dispersed. In the present invention the intermediate layer of refractive index less than that of the transparent layer is made up of a finely dispersed fluorine compound such as cryolite or sodium fluosilicate dispersed in a protective film of a binder such as cellulose acetate or polymethyl methacrylate. It is an advantage to use a protective binder having, itself, as low a refractive index as possible. The refractive index of the composite material is not easy to measure since it does not give a sharp critical angle of internal reflection when placed on an Abbe refractometer, but nevertheless, practical tests have shown that the index of refraction is quite low and that the material is capable of giving and does give, a remarkable diminution in stain level when used in colour photographs. There is in most cases a certain residual degree of diffusivity in the intermediate layer due to the dispersed particles, but in practice this is negligible.

The invention, as will be clear from application No. 7756/44 (Serial No. 600,310) is useful in connection with antihalation layers as well as in con-

nection with coloured photographic transparencies, since it eliminates the need for the high density layers hitherto used.

According to the present invention there is provided a photograph or sensitive photographic material having a light diffusing layer adjacent to one face of a transparent layer whose other face is in contact with a medium of lower refractive index such as air, in which there is arranged between said light diffusing layer and said transparent layer a continuous solid layer having an index of refraction at least 0.08 less than that of the transparent layer and having a thickness between .00005 and .005 inches. The transparent layer may be an image-bearing layer and the light-diffusing layer may consist of a layer of transparent material having the light diffusing medium in optical contact with the rear face thereof or distributed there-through.

The invention includes a colour photograph having a multi-coloured transparency secured to a light-diffusing backing and between them a continuous solid layer having an index of refraction at least 0.08 less than that of the said transparency and having a thickness between .00005 and .005 inches, preferably not exceeding .001 inches. In this case also the light-diffusing layer may consist of a layer of transparent material having the light-diffusing medium in optical contact with the rear face thereof or distributed there-through.

The invention further includes a sensitive photographic material having a light-diffusing translucent emulsion layer secured to a transparent support and between a continuous solid layer having an index of refraction at least 0.08 less than that of the said emulsion layer and having a thickness between .00005 and .005 inches.

Preferably the solid layer consists of a fluorine compound such as cryolite or sodium fluosilicate in a protective film of resinous material such as cellulose acetate or polymethyl methacrylate, preferably a resinous material of as low refractive index as possible.

The most useful effect is obtained when the ratio of fluorine compound to vehicle is greater than 1:2. Similarly over 50% of the dispersed particles should be smaller than .2 microns in diameter, preferably about .1 micron but actually there is no lower limit on the invention except of course that particles of molecular size do not constitute dispersed particles. Particles larger than .2 microns increase the diffusivity of the layer making it act more like the paper base itself and thus the larger particles might conceivably reduce the efficiency of the present invention aside from the fact that they do not aid in reducing the index of refraction and hence are wasted.

These layers can be applied to the photographic support, whether this is transparent or light-diffusing, like a subbing layer.

For antihalation, the low index layer must be within 0.005 inches of the emulsion layer in order to have a useful degree of antihalation effect and must in general be more than 0.00005 inches thick in order to avoid the possibility of Newton's rings. When the solvent in the subbing is relatively active, it "cuts into" the support and reduces the sharpness of the interface; coatings only 0.00002 are often satisfactory under these circumstances. In all cases however, the thickness must be greater than that at which these interference patterns appear.

This antihalation arrangement is particularly useful when combined with an ordinary antihalation dye layer on the back of the film, which antihalation dye layer has an optical density measured at normal incidence less than 0.2. Not only are such low density layers easier to manufacture uniformly, but they can be used in colour processes which require exposure through the base. In the antihalation arrangement it is also particularly useful to employ an emulsion layer having a high index of refraction, i.e. greater than 1.6, coated on a support made up of a plurality of layers all having an index of refraction less than 1.52. If, however, there is a low index subbing between an emulsion layer and the support the layers of this support may have normal indices of refraction about 1.5. This combination of a high index emulsion layer and a low index intermediate layer enhances the effect very greatly and thus a preferred embodiment of the invention has a high index emulsion layer, a low index subbing layer and a normal index (about 1.5) film support. For the sake of definiteness, the range of normal indices of refraction is specified as 1.48 to 1.55, which range includes most cellulose derivatives and gelatin emulsions.

The invention therefore includes an antihalation photographic film comprising a plurality of laminated layers including a translucent sensitive emulsion layer having a sensitive material dispersed in a vehicle and a plurality of transparent supporting layers at least one of which has a thickness greater than that at which optical interference

patterns appear, is within 0.005 inches of said emulsion layer and has an index of refraction at least 0.08 less than that of said vehicle.

One of the supporting layers of such a film may be a light absorbing layer with an optical density measured at normal incidence less than 0.2.

The preferred embodiment of the invention employs a low index supporting layer or subbing which contains more than 30% by weight of a fluorine compound such as fluoride salt. The higher the percentage of fluorine compound, the lower the index of refraction and hence the greater the desired effect. However, fluoride salts or other fluorine compounds must be carried in a suitable vehicle, compatible both with the film support and with the emulsion layer and stable, at least mechanically stable, under the action of the various processing solutions to which the photographic layer will be subject after exposure, in the case of a sensitive material. Thus, in this case the fluorine compound should be carried in a transparent vehicle having a low water permeability, sufficiently low to prevent wandering of the fluorine compound into adjacent layers during the manufacture of the film. In certain embodiments of the invention, in order to step up the index of refraction of the emulsion layer it preferably contains a high percentage of a high index material.

In order to test antihalation effects quantitatively many different halation latitude criteria have been proposed. A Kuster in Phot. Korr 71 No. 6, p. 73—75, and No. 5, p. 65—68, published " An Objective Method For The Determination of Halation " which is quite satisfactory for this purpose. Kuster used arbitrary step numbers for comparison of halation factors but density differences or differences in the logarithm of the exposure are for many purposes even better, using the same optical system of course. With these systems, the halation factors are merely relative and the particular factors given below are intended only for comparison one with the other.

Various fluorine compounds such as fluorine salts of lithium, sodium, potassium, magnesium, rubidium, and ammonium, or mixed salts such as cryolite, cryolithiolite, fluosilicates, and fluoborates may be used. All of these are fluoride salts having low indices of refraction. It has been found that the higher the percentage of fluoride salt which can be dissolved in a vehicle such as cellulose nitrate or cellulose acetate or cellulose ether, the more is the effect in reducing halation. A carrier containing about 50% by weight of a fluoride salt appears to be quite satisfactory; there should be at least 30% of the fluoride by weight. For example 0.8% by weight of sodium fluoroborate in a 1% by weight solution of cellulose nitrate, in a suitable solvent such as 10% methyl ethylene glycol monomethyl ether and the balance methyl alcohol forms a satisfactory coating solution, the cellulose nitrate being one with high ethyl alcohol solubility, medium viscosity and low nitrogen content about 11%. Such nitrates are known to be suitable for subbing. The index of refraction of the layer is about 1.4 or less.

The halation latitude specifically gained by any particular subbing appears to depend on the vehicle in which the fluoride salt is coated and on the particular fluoride salt use.

A given film with no dye and with no antihalation subbing according to the present invention has a halation latitude of 1.15 when tested as described above, the factor being on a more or less arbitrary scale measuring log of exposure range. An ordinary antihalation backing increases this latitude to about 2.0 or event to 2.25 but this requires a high optical density in the dye layer which is difficult to coat uniformly and which is objectionable for certain purposes to which the film is put. Any increase in the halation latitude is of course desirable but an increase to about 1.35 or 1.5 is necessary if the effect is to be worthwhile from a practical point of view. Obviously if one were able to get such an increase in halation latitude without any dye layer, only a relatively low density dye layer would be required to bring the halation latitude all the way up to 2.0. In fact the two systems for reducing halation appear to combine more than simple additively, in that a low index subbing which alone increases the latitude from 1.15 to 1.35 combined with a dye layer which alone gives a similar increase in latitude results in a total effect greater than the sum of these two increases. Specifically the sodium fluoborate in cellulose nitrate in a ration of 8:10 by weight as described above has resulted in an increase of halation latitude from 1.15 to 1.56. This is an exceptionally useful effect either alone or combined with a dye layer. This same low index subbing layer when combined with a dye backing which dye layer had a density of only .07 gave a halation latitude of 1.65 and when a dye layer of density .099 was used the value went up to 1.74. The main difficulties with prior dye backings arose only when high

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concentrations of dye greater than .2 density were used. With the present invention, adequate halation latitude is obtained with dye densities less than .2.

In the present invention, the low index layer may contain a fluorine compound in solution in the vehicle or in the form of a fine dispersion. In the former case the fluorine compound must stay in solution in its vehicle; of the above listed fluorine compounds, those such as cryolite which are difficult to dissolve are therefore the more difficult to use in this form of the invention. (Even if a slightly diffusing layer were devised which gave a useful reduction of halation and which became transparent during processing of the film, the presence of such a diffusing layer would cause or hide defects which would not disappear in the processing). However, if the particles are less than .2 microns in diameter, no effective diffusion is introduced. Certainly any slight residual diffusivity is not objectionable when used in colour prints.

Dated this 24th day of October, 1946.
W. P. THOMPSON & CO.,
12, Church Street, Liverpool, 1.
Chartered Patent Agents.

COMPLETE SPECIFICATION

Improvements in and relating to Photographs and to Sensitive Photographic Materials

We, KODAK LIMITED, a Company registered under the Laws of Great Britain, of Kodak House, Kingsway, London, W.C.2, do hereby declare the nature of this invention which has been communicated to us by EASTMAN KODAK COMPANY, a Company organised under the Laws of the State of New Jersey, United States of America, of 343, State Street, Rochester, New York, United States of America, and GALE FRANCIS NADEAU, a Citizen of the United States of America, and EDWIN ERNEST JELLEY, a Citizen of the United States of America, both of Kodak Park, Rochester, New York, United States of America, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in sensitive photographic materials and in photographic colour prints and has for its object to reduce the scattering of light therein.

It is known that photographs and sensitive photographic materials wherein a light diffusing layer is adjacent to one face of a transparent layer whose other face is in contact with a medium of lower refractive index such as air suffer from certain disadvantages. One example is a colour photograph having a multi-coloured transparent layer mounted for viewing on a light diffusing support. In such a case there is an appearance of high-light stain not noticeable in the transparency itself and an apparent reduction in colour saturation. Another example is a sensitive emulsion, which consists of a translucent but light-diffusing layer, mounted on a transparent support in which the defect known as halation occurs. Both these defects are due to scattering of light by internal reflection.

In specification No. 600,310 we have shown that these disadvantages can be eliminated or largely reduced by arranging between the light-diffusing layer and the transparent layer an intermediate layer of refractive index less than that of the transparent layer, e.g. a thin layer of air. It is best for the intermediate layer to be continuous but when this is air constructional difficulties may be encountered. It has now been found that it is possible to use for such intermediate layer a solid layer having therein finely divided particles, for instance a resinous layer containing a substantial proportion of a fluoride. The fluoride may be in a solution. It has been further discovered, however, that the index of refraction of a layer is actually affected by materials dispersed therein provided the particles are less than .2 microns in diameter. Particles about .1 micron are of course far above molecular dimensions and yet they do contribute to the refractive index of the medium in which they are dispersed. In the present invention the intermediate layer of refractive index less than that of the transparent layer may be made up of a finely dispersed fluoride such as cryolite or sodium fluosilicate dispersed in a protective vehicle of plastic material such as cellulose acetate or polymethyl methacrylate. It is an advantage to use a protective vehicle having, itself, as low a refractive index as possible. The refractive index of the composite material is not easy to measure since it

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does not give a sharp critical angle of internal reflection when placed on an Abbe refractometer, but nevertheless, practical tests have shown that the index of refraction is quite low and that the material is capable of giving and does give a remarkable diminution in stain level when used in colour photographs. There is in most cases a certain residual degree of diffusivity in the intermediate layer due to the dispersed particles, but in practice this is negligible.

The invention, as will be clear from Specification No. 600,310, is useful in connection with antihalation layers as well as in connection with coloured photographic transparencies, since it eliminates the need for the high density layers hitherto used.

According to the present invention, the method of reducing the scattering of light in a photographic material having a transparent layer on a light-diffusing support or a translucent but light-diffusing layer on a transparent support, comprises providing between the said transparent and said light-diffusing layers a continuous solid layer which (a) has a thickness greater than that at which interference patterns occur but less than 0.005 inches and (b) has an index of refraction at least 0.08 less than that of the vehicle of the said transparent layer.

On example of such photographic material is a sensitive film where the translucent layer is a light sensitive emulsion and the support is the customary transparent film support. Another example of such photographic material is a colour print where the transparent layer is the image-bearing layer and the support is a light-diffusing layer which may consist of a layer of transparent material having the light-diffusing medium in optical contact with the rear face thereof or distributed therethrough.

The invention includes an antihalation photographic film comprising a translucent emulsion between said emulsion layer and the main supporting layer, a continuous solid layer which (a) has a thickness greater than that at which optical interference patterns appear, but less than 0.005 inches and (b) has an index of refraction at least 0.08 less than that of the vehicle of said emulsion layer.

It will be appreciated that in a photographic film the support for the translucent emulsion layer includes a main supporting layer, generally composed of a cellulose derivative such as a cellulose ester, but usually also includes at least one auxiliary layer such as a subbing layer and may include an auxiliary layer such as an antihalation coating on the back of the main supporting layer. The continuous solid layer having the properties defined above which is, according to the invention, provided between the emulsion layer and the main supporting layer may conveniently constitute the subbing layer.

For the sake of definiteness, the range of normalin dices of refraction is specified as 1.48 to 1.55, which range includes most cellulose derivatives and gelatin emulsions.

The said continuous solid layer may have a thickness between .00005 and .005 inches, preferably not exceeding .001 inches and may have an index of refraction at least 0.15 less than that of the emulsion layer.

In general it must be more than 0.00005 inches thick in order to avoid the possibility of Newton's rings but when it is a subbing layer, the solvent for which is relatively active, it "cuts into" the support and reduces the sharpness of the interface; coatings only 0.00002 inches are often satisfactory under these circumstances. In all cases however, the thickness must be greater than that at which these interference patterns appear.

This antihalation arrangement is particularly useful when combined with an ordinary antihalation dye layer on the back of the film, which antihalation dye layer has an optical density measured at normal incidence less than 0.2. Not only are such low density layers easier to manufacture uniformly, but they can be used in colour processes which require exposure through the base.

The preferred embodiment of the invention employs a low index layer which contains more than 30% by weight of a fluoride between the transparent or translucent layer and the support. The higher the percentage of fluoride, the lower the index of refraction and hence the greater the desired effect. However, the fluoride must be carried in a suitable vehicle, compatible both with the film support and with the emulsion layer and stable, at least mechanically stable, under the action of the various processing solutions to which the photographic layer will be subject after exposure in the case of a sensitive material. Thus, in this case the fluoride should be carried in a transparent vehicle having a low water permeability, sufficiently low to prevent wandering of the fluoride into adjacent layers during the manufacture of the film.

In order to test antihalation effects quantitatively many different halation latitude criteria have been proposed. A. Kuster in Phot. Korr 71 No. 6, p. 73—75, and No. 5, p. 65—68, published "an

Objective Method For The Determination of Halation " which is quite satisfactory for this purpose. Kuster used arbitrary step numbers for comparison of halation factors, but density differences or differences in the logarithm of the exposure are for many purposes even better, using the same optical system of course. With these systems, the halation factors are merely relative and the particular factors given below are intended only for comparison one with the other.

Various fluorides such as the fluorides of lithium, sodium, potassium, magnesium, rubidium, and ammonium, or mixed salts such as cryolite, cryolithiolite, fluosilicates, and fluoborates may be used. All of these inorganic fluorides have low indices of refraction. It has been found that the higher the percentage of fluoride which can be dissolved in a vehicle such as cellulose nitrate or cellulose acetate or cellulose ether, the more is the effect in reducing halation. A carrier containing about 50% by weight of fluoride appears to be quite satisfactory; there should be at least 30% of the fluoride by weight. For example 0.8% by weight of sodium fluoroborate in a 1% by weight solution of cellulose nitrate, in a suitable solvent such as 10% ethylene glycol monomethyl ether and the balance methyl alcohol forms a satisfactory coating solution, the cellulose nitrate being one with high ethyl alcohol solubility, medium viscosity and low nitrogen content about 11%. Such nitrates are known to be suitable for subbing. The index of refraction of the layer is about 1.4 or less.

The halation latitude specifically gained by any particular subbing appears to depend on the vehicle in which the fluoride is coated and on the particular fluoride used.

A given film with no dye and with no antihalation subbing according to the present invention has a halation latitude of 1.15 when tested as described above, the factor being on a more or less arbitrary scale measuring log of exposure range. An ordinary antihalation backing increases this latitude to about 2.0 or even to 2.25 but this requires a high optical density in the dye layer which is difficult to coat uniformly and which is objectionable for certain purposes to which the film is put. Any increase in the halation latitude is of course desirable but an increase to about 1.35 or 1.5 is necessary if the effect is to be worthwhile from a practical point of view. Obviously if one were able to get such an increase in halation latitude without any dye layer, only a relatively low density dye layer would be required to bring the halation latitude all the way up to 2.0. In fact the two systems for reducing halation appear to combine more than simply additively, in that a low index subbing which alone increases the latitude from 1.15 to 1.35 combined with a dye layer which alone gives a similar increase in latitude results in a total effect greater than the sum of these two increases. Specifically the sodium fluoroborate in cellulose nitrate in a ratio of 8:10 by weight as described above as resulted in an increase of halation latitude from 1.15 to 1.56. This is an exceptionally useful effect either alone or combined with a dye layer. This same low index subbing layer when combined with a dye backing which dye layer had a density of only .07 gave a halation latitude of 1.65 and when a dye layer of density .099 was used the value went up to 1.74. The main difficulties with prior dye backings arose only when high concentrations of dye greater than .2 density were used. With the present invention, adequate halation latitude is obtained with dye densities less than .2.

In the present invention, the low index layer may contain a fluoride in solution in the vehicle or in the form of a fine dispersion. In the former case the fluoride must stay in solution in its vehicle; of the above listed fluorides, those such as cryolite which are difficult to dissolve are therefore the more difficult to use in this form of the invention. (Even if a slightly diffusing layer were devised which gave a useful reduction of halation and which became transparent during processing of the film, the presence of such a diffusing layer would cause or hide defects which would not disappear in the processing.) However, if the particles are less than .2 microns in diameter, no effective diffusion is introduced. Certainly any slight residual diffusivity is not objectionable when used in colour prints. Accordingly we may use a fine dispersion of fluoride in a transparent vehicle of plastic material, the ratio of fluoride to vehicle being greater than 1:2 by weight and more than 50% of the dispersed particles being smaller than 0.2 microns.

The most useful effect is obtained when the ratio of fluoride to vehicle is greater than 1:2 by weight. Preferably there is over 50% by weight of fluoride. Similarly over 50% of the dispersed particles should be smaller than .2 microns in diameter, preferably about .1 micron but actually there is no lower limit of size except of course that particles of molecular size do not constitute dispersed particles. Particles larger than .2 microns increase the diffusivity of the layer mak-

ing it act more like the paper base itself and thus the larger particles might conceivably reduce the efficiency of the present invention aside from the fact that they do not aid in reducing the index of refraction and hence are wasted.

The invention also includes a photographic colour print having a layer containing a transparent multicoloured image on a white light diffusing support in which there is provided between the image layer and the support a continuous solid layer which (a) has a thickness greater than that at which optical interference patterns appear but less than 0.005 inches, (b) has an index of refraction at least 0.08 less than that of the vehicle of the image layer and (c) contains more than 30% by weight of fluoride, the remainder of the layer being a transparent vehicle of plastic material having a sufficiently low water permeability to prevent wandering of the fluoride into adjacent layers during manufacture of the print.

The fluoride may be dissolved in the plastic vehicle as described above for the antihalation embodiment of the invention and may be on alkali metal or ammonium fluoride.

The invention further includes a photographic colour print having a layer containing a transparent multicoloured image on a white light diffusing support in which there is provided between the image layer and the support a continuous solid layer which (a) has a thickness greater than that at which optical interference patterns appear but less than 0.005 inches, (b) has an index of refraction at least 0.08 less than that of the vehicle of the image layer and (c) is composed of a fine dispersion of fluoride in a transparent vehicle of plastic material, the ratio of fluoride to vehicle being greater than 1:2 by weight and more than 50% of the dispersed particles being smaller than 0.2 microns in diameter.

In this case the fluoride may be cryolite or sodium fluosilicate and the plastic vehicle may be cellulose ester or polyalkyl methacrylate as described above for the antihalation embodiment of the invention. The amount of fluoride preferably constitutes at least 50% by weight of the layer which is preferably between 0.005 and 0.00005 inches thick.

In the accompanying drawings:—

Figure 1 illustrates the optical phenomenon, halation,

Figure 2 shows how this halation is customarily reduced by a dye layer on the back of the support,

Figures 3 and 4 show how this halation is reduced by the present invention, and

Figure 5 shows how one embodiment of the invention can be employed in a colour print.

In figure 1 a translucent emulsion layer 10 is coated on a support made up of a transparent subbing layer 11 and a transparent flexible film 12. Light diffused by the emulsion as indicated by the ray 15 is reflected by Fresney reflection from the back of the support 12 and as indicated by the ray 16 is directed toward the emulsion, fogging it at some distance from the point of the original image point from which the ray 15 came. This causes the well-known halation or spreading of the light in photographic films. Figure 2 shows one prior method of reducing this halation. The emulsion layer 20 coated on subbing 21 and support 22 forms a film which is provided with a dye layer 23 having an optical density which reduces the intensity of the light reflected from the rear surface of the film. This reduced intensity ray is indicated by the broken line 26. The halation causing light must travel twice through the dye layer 23 and travels through greater thicknesses thereof when it strikes this layer at greater obliquity. Thus the dye layer is quite efficient in reducing halation since the more oblique rays are the source of the more objectionable halation. However, it is not easy to coat high density halation layers since they must of course be removed (usually by washing out of the dye) during the processing of the film so as not to interfere with subsequent printing operations. Also certain films must be exposed through the base and the speed of the film would be greatly reduced by a high density antihalation layer coated on the back of the support.

According to the embodiment of the invention shown in Figure 3, the emulsion layer 30 is coated on subbing 31 and support 32. The subbing layer 31 has an index of refraction at least 0.08 less than that of the emulsion layer 30 and has a thickness greater than 0.00005 inches but less than 0.005 inches. Obliquely scattered rays such as the ray 35 are totally internally reflected within the emulsion layer 30 as indicated by the ray 36 which has not travelled far enough to cause any harm. The rays which are less oblique are reduced in intensity (at both interfaces) as indicated by the ray 37 and since the layers 30 and 32 have approximately the same index of refraction, the obliquity of this ray is not greatly changed by its transmission through the subbing layer 31. Thus, that part of the scattered light which does get through as indicated by the broken line 37 has greatly reduced intensity and the halation

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causing light indicated by the line 39 has quite low intensity. As shown in Figure 4, the intensity of this ray may be further reduced by an antihalation dye layer 43, of relatively low density.

In figure 4, the emulsion layer 40 is coated on a subbing layer 41 and a support 42 having an antihalation layer 43 which still further reduces the halation producing light produced by reflection of ray 47, as indicated by the short line 49. In both of these arrangements, however, the rays represented by the line 37 or 47 as the case may be, travel further before total internal reflection, than they would if they were totally internally reflected in the emulsion layer and hence, the halation is spread far although with reduced intensity.

Figure 5 illustrates the application of the form of low index layer consisting of a high percentage of fluoride to the reduction of light diffusion in viewing colour transparencies. In Figure 5, a colour print consists of a transparent multicolour dye image in the top layer 90 on a light diffusing support 92 such as paper, the layers being separated by a low index, fluoride containing layer 91.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed as communicated to us by our foreign correspondents, we declare that what we claim is: —

1. A method of reducing the scattering of light in a photographic material having a transparent layer on a light-diffusing support or a translucent but light-diffusing layer on a transparent support which comprises providing between the said transparent and said light-diffusing layers a continuous solid layer which (a) has a thickness greater than that at which optical interference patterns appear, but less than 0.005 inches and (b) has an index of refraction at least 0.08 less than that of the vehicle of the said transparent or translucent layer.

2. An antihalation photographic film comprising a translucent emulsion layer on a transparent support in which there is provided between said emulsion layer and the main supporting layer, a continuous solid layer which (a) has a thickness greater than that at which optical interference patterns appear, but less than 0.005 inches and (b) has an index of refraction at least 0.08 less than that of the vehicle of said emulsion layer.

3. An antihalation photographic film as claimed in claim 2, in which the thickness of the said continuous solid layer is between 0.005 and 0.00005 inches.

4. An antihalation photographic film as claimed in claim 2 or 3, in which the said continuous solid layer has an index of refraction at least 0.15 less than that of the vehicle of said emulsion layer.

5. An antihalation photographic film as claimed in any of claims 2 to 4, in which the vehicle of the translucent emulsion layer and the main supporting layer have indices of refraction between 1.48 and 1.55.

6. An antihalation photographic film as claimed in any of claims 2 to 5, in which the continuous solid layer between the translucent emulsion layer and the main supporting layer contains more than 30% by weight of a fluoride, the remainder of the layer being a transparent vehicle of plastic material having sufficiently low water permeability to prevent wandering of the fluoride into adjacent layers during manufacture of the film.

7. An antihalation photographic film as claimed in claim 6, in which the fluoride is dissolved in the plastic vehicle.

8. An antihalation photographic film as claimed in claim 6 or 7, in which the fluoride is an alkali metal or ammonium fluoride.

9. An antihalation photographic film as claimed in any of claims 2 to 5, in which the continuous solid layer between the translucent emulsion layer and the main supporting layer is composed of a fine dispersion of a fluoride in a transparent vehicle of plastic material, the ratio of fluoride to vehicle being greater than 1:2 by weight and more than 50% of the dispersed particles being smaller than 0.2 microns in diameter.

10. An antihalation photographic film as claimed in claim 9, in which the fluoride is cryolite or sodium fluosilicate and the plastic vehicle is cellulose ester or polyalkyl methacrylate.

11. An antihalation photographic film as claimed in any of claims 6 to 10, in which the continuous solid layer between the translucent emulsion layer and the main supporting layer contains at least 50% by weight of fluoride.

12. An antihalation photographic film as claimed in any of claims 2 to 11, in which said main cupporting layer consists mainly of a cellulose derivative and the continuous solid layer between said main supporting layer and said emulsion layer is a subbing layer.

13. An antihalation photographic film as claimed in any of claims 2 to 12 having on the back of the main supporting layer an antihalation dye layer having a density measured at normal incidence less than 0.2.

14. A photographic colour print having a layer containing a transparent

multicoloured image on a white light diffusing support in which there is provided between the image layer and the support a continuous solid layer which (a) has a thickness greater than that at which optical interference patterns appear but less than 0.005 inches, (b) has an index of refraction at least 0.08 less than that of the vehicle of the image layer and (c) contains more than 30% by weight of fluoride, the remainder of the layer being a transparent vehicle of plastic material having a sufficiently low water permeability to prevent wandering of the fluoride into adjacent layers during manufacture of the print.

15. A photographic colour print as claimed in claim 14, in which the fluoride is dissolved in the plastic vehicle.

16. A photographic colour print as claimed in claim 14 or 15 in which the fluoride is an alkali metal or ammonium fluoride.

17. A photographic colour print having a layer containing a transparent multicoloured image on a white light diffusing support in which there is provided between the image layer and the support a continuous solid layer which (a) has a thickness greater than that at which optical interference patterns appear but less than 0.005 inches, (b) has an index of refraction at least 0.08 less than that of the vehicle of the image layer and (c) is composed of a fine dispersion of fluoride in a transparent vehicle of plastic material, the ratio of fluoride to vehicle being greater than 1:2 by weight and more than 50% of the dispersed particles being smaller than 0.2 microns in diameter.

18. A photographic colour print as claimed in claim 17 in which the fluoride is cryolite or sodium fluosilicate and the plastic vehicle is a cellulose ester or poly alkyl methacrylate.

19. A photographic colour print as claimed in any of claims 14 to 18 in which the said continuous solid layer between the image layer and the support contains at least 50% by weight of fluoride.

20. A photographic colour print as claimed in any of claims 14 to 19 in which the said continuous solid layer between the image layer and the support is between 0.005 and 0.00005 inches thick.

21. The method of reducing the scattering of light in a photographic material as herein particularly described.

22. Antihalation photographic films and photographic colour prints as herein particularly described.

Dated this 21st day of November, 1947.

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[This Drawing is a reproduction of the Original on a reduced scale.]

FIG.1.

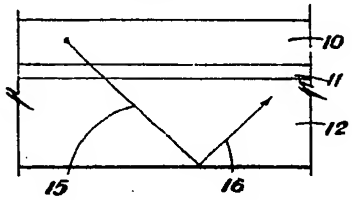

FIG.2.

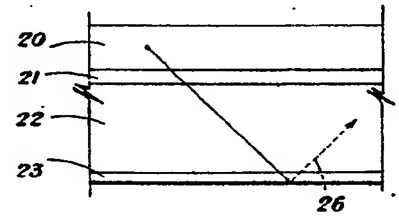

FIG.3.

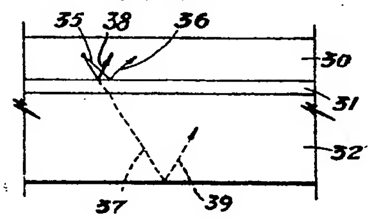

FIG.4.

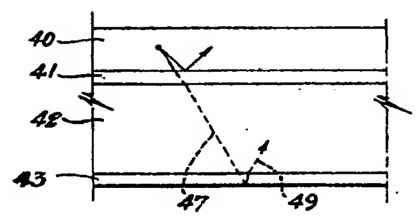

FIG.5.